

## APPENDIX E

### PHYSICAL ASSESSMENT OF THE ST. REGIS RIVER AND TRIBUTARIES

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#### Introduction

The St. Regis River was divided into 10 reaches for the TMDL assessment. Ten percent of each reach (except Reach 10 in the headwaters) was walked and physical measurements were made (**Table E-1**). Assessment sites were selected using aerial photographs and on-the ground observations to represent conditions at the reach scale. Overall, 3.7 miles (19,700 feet) of the St. Regis River were assessed in the field between July 7 and July 11, 2003. Pool and large woody debris inventories were adapted from the R1/R4 methodology employed by the Lolo National Forest (USDA 1997). In addition, cross section measurements were taken in Reaches 3, 5, and 6 to compliment reaches surveyed by the Lolo National Forest. Once the walk-thru was completed for each reach, the overall condition of the reach was assessed by the two person field crew based on the Proper Functioning Condition protocol developed by the Bureau of Land Management (BLM 1998). Three tributaries were also assessed: Little Joe Creek, Twelvemile Creek, and Big Creek. Tributary reaches were assessed from the National Forest boundary to the confluence with the St. Regis River between October 1 and October 3, 2002, except for the cross section measurements on Twelvemile Creek, which were made in July of 2003. Overall, 1.0 mile of Little Joe Creek, 2.3 miles of Twelvemile Creek, and 0.3 miles of Big Creek were assessed. In addition, several culverts were assessed for fish passage during field work in the summer of 2003.

**Table E-1. Physical stream assessment sites along the St. Regis River**

Reach	Description	Length (Feet)	Stationing
1	Clark Fork River to Twomile Creek	2,300	16,500-18,800
2	Twomile Creek to Ward Creek	1,900	23,600-25,500
3	Ward Creek to Twelvemile Creek	2,600	65,400-68,000
4	Twelvemile Creek to Deer Creek	2,300	81,000-83,300
5	Deer Creek to Haugan	2,300	104,200-106,500
6	Haugan to Saltese	2,500	130,500-133,000
7	Saltese to Taft	2,400	142,000-144,400
8	Taft to Hanakar Creek	1,600	167,700-169,300
9	Hanakar Creek to Northern Pacific Railroad Grade	1,800	179,000-180,800

#### Methods

##### *Pools*

The size and frequency of pools were measured in the mainstem of the St. Regis River and in three tributaries. The first ten pools encountered were measured in each of the nine subreaches along the mainstem of the St. Regis River. The length, width, maximum depth, and pool tail-out depth were measured for each pool (USDA 1997). The length and width of each pool was determined based on channel bed features, while depth measurements are related to the stream

flow during field work, which was conducted during low flow conditions ranging from approximately 200-400 CFS (USGS 2003, provisional data). The length, width, maximum depth, and pool tail-out depth were measured for every pool within the three tributary reaches. In the tributaries, the length of stable bank along each pool for both the right and left banks was quantified and the quality of each pool was described as low, medium, high, or very high. Pool quality assessments were based on best professional judgment. Shallow pools that lacked cover were described as low quality, while deep pools with good cover were described as high quality.

Pool measurements were used to determine mean pool dimensions, pool area, and pool frequency. Pool area, which provides a measure of the relative amount of pool habitat available in the stream, was calculated as the overall percent of the reach occupied by pools. Pool area was determined using the sum of individual pool areas, the mean bankfull channel width, and the overall reach length. Pool area was also calculated based on wetted width for Little Joe Creek and Big Creek so that comparisons to reference conditions on the Lolo National Forest, which are based on wetted width, could be made (Riggers et al. 1998). In addition, pool frequency was calculated as the total number of pools per mile.

### ***Large Woody Debris***

The amount of large woody debris was determined for each reach along the mainstem of the St. Regis River and in the three tributary reaches. Large woody debris was defined as relatively stable pieces of woody material greater than 9 feet in length with a diameter greater than 4 inches one third of the way from the base that are hydrologically functioning (USDA 1997). The number of large woody debris, the number of aggregates, and the number of logs per aggregate were determined in each of the 9 reaches. The amount of large woody debris per mile was determined by multiplying the number of aggregates by the average number of large woody debris per aggregate and adding this to the single pieces of large woody debris.

### ***Cross Section Measurements***

Channel cross section measurements were made in riffles in Reaches 3, 5, and 6 along the St. Regis River, as well as in Little Joe Creek, Twelvemile Creek, and Big Creek. Bankfull width, flood prone width, mean bankfull depth, and maximum bankfull depth were measured at 3 transects in each mainstem reach using a line level and a stadia rod. Cross section measurements were made at three sites along Little Joe Creek and Twelvemile Creek, and at two sites along Big Creek. A pebble count and 3 grid tosses were also performed along each transect in the mainstem, while only the pebble count was performed in the tributaries. A grid with 49 intersections was used for the grid toss in riffles and all particles smaller than the 6 mm intersections were counted (Kramer et al. 1993). In addition, the dominant size large particle on adjacent gravel bars was sampled at each transect in the mainstem following methods developed by Kappeser (2002). Cross section measurements were used to determine the width/depth ratio, the entrenchment ratio, Rosgen stream type, the D<sub>50</sub> particle size, the D<sub>84</sub> particle size, and the percent of surface fines (PSF). The riffle stability index, which is an indicator of sediment load, was determined using pebble count results and dominant large particle size measurements from adjacent gravel bars.

### ***Fish Passage Assessment***

Twelve culverts were assessed for their ability to allow fish passage. Best professional judgment was used to determine if a culvert was a potential barrier to fish passage. This was based on the length and slope of the culvert, and whether there was a drop at the outlet. Nine culverts were assessed on tributaries and three on the mainstem of the St. Regis River. Culverts running under Interstate 90 were assessed on Twelvemile, Twin, Savenac, and Randolph Creeks along with the St. Regis River. Frontage Road crossings over Twin Creek and Savenac Creek were also assessed, along with several other tributary crossings.

## **Results**

### ***Mainstem Pools***

Pool dimensions, frequency, and area along the mainstem of the St. Regis River varied based on the size and type of the stream channel as well as the relative amount of channel alterations. The maximum depth and tail-out depth of pools generally increased progressing downstream, while the length and width of pools remained fairly constant throughout the sampled reaches. The exception was Reach 3, in which the pools were smaller than in any other reach, with maximum depths and tail-out depths lower than upstream and downstream reaches. Reach 3 also had the highest amount of stream bank alterations (see channel report). Pool frequency, as indicated by the number of pools per mile, ranged from 0 in Reach 6 to more than 29 in Reach 9 (**Table E-2**). Reaches 4, 8, and 9 had the highest frequency of pools, with the number of pools per mile ranging from 18 to 23. Overall, pools occupied a small portion of the St. Regis River, covering only 0% to greater than 1.49% of the overall bankfull surface area. Reach 7, which is a highly channelized step-pool B-type channel, had the highest amount of pool area, followed by Reaches 4, 8, and 9. Reaches with F-type stream channels had the least amount of pools with the lowest pool area values of any sampled reaches. The F-type stream channels along the St. Regis River are likely former C-type channels that are now confined by riprap.

**Table E-2. Mean pool dimensions for Reaches 1-9 along the St. Regis River measured on July 7-11, 2003 (measurements in feet)**

Reach	Length	Width	Maximum Depth	Tail-Out Depth	#/ Mile	Pool Area	Channel Type
1	18.4	9.2	5.7	3.8	11	0.24%	C3
2	13	9	4.6	3.2	3	0.08%	F3
3	7.8	5.3	3.1	2.5	8	0.09%	F3
4	14.8	8.1	4.1	3	21	0.55%	C3
5	14.5	9.8	4.7	3.6	9	0.23%	C4
6	0	0	0	0	0	0.00%	F3
7	14.6	8.6	3.2	2.1	18	1.46%	B3c
8	13.3	8.4	2.4	1.7	23	1.14%	C4
9	11	6	2.1	1.5	>29	>1.49%	C3b

Pools occurred more frequently in the tributaries than in the mainstem of the St. Regis River. Wetted width measurements for Little Joe Creek and Big Creek indicate pools occupy 7.2% and 7.8% of these reaches respectively (**Table E-3**). This value is below the reference condition of 23% for C4 channels in these two tributaries (Riggers et al. 1998). Little Joe Creek had 0% eroding banks associated with pools, while Twelvemile Creek had 1.7-2.7%, and Big Creek had

54.0-69.0%. Reference conditions of 0.36% for these stream types are exceeded in Twelvemile Creek and Big Creek (Riggers et al. 1998). Overall, Big Creek had the most eroding bank and the largest and shallowest pools. Eighty percent of the pools in the sampled reach of Little Joe Creek were low quality, 26% were medium quality, and 56% were high to very high quality pools, while Twelvemile Creek had 40% low quality pools, 25% medium quality pools, and 29% high to very high quality pools, and Big Creek had 80% low quality pools, 13% medium quality pools, and 7 % high to very high quality pools. Thus, Little Joe Creek had the highest quality pools overall, followed by Twelvemile Creek, while Big Creek had the lowest quality pools.

**Table E-3. Mean pool dimensions in St. Regis River tributaries measured on October 1-3, 2002** (measurements in feet)

Tributary	Length	Width	Maximum Depth	Tail-out Depth	# / Mile	Pool Area	Left Eroding Bank	Right Eroding Bank
Little Joe	20.6	9.5	2.2	0.8	38	2.9%(7.2%)	0.0%	0.0%
Twelvemile	15.6	7.5	2.0	0.8	41	2.5%	1.7%	2.7%
Big	20.9	10.0	1.8	0.7	45	4.5%(7.8%)	54.0%	69.0%

Parentheses indicate the use of wetted width.

#### ***Mainstem Large Woody Debris***

The amount of large woody debris was generally low along the majority of the mainstem of the St. Regis River. The highest amount of large woody debris was 230 pieces per mile (143 pieces/km) in Reach 4, which contains a large amount of both single pieces and aggregates (**Table E-4**). Reaches 1, 5, and 8 contained 66-73 pieces per mile, while the rest of the reaches contained very little large woody debris. A blow down has deposited numerous trees from the river left bank in Reach 2. However, these trees were not counted since they had not yet lead to any morphological change of the stream substrate.

**Table E-4. Large woody debris in Reaches 1**

Reach	Length (Feet)	LWD	Aggregates	#/Aggregate	Pieces/Mile
1	2,300	2	5	6	73
2	1,900	blow down	blow down	blow down	blow down
3	2,600	2	0	0	4
4	2,300	9	7	13	230
5	2,300	11	4	5	71
6	2,500	0	0	0	0
7	2,400	3	1	5	18
8	1,600	8	2	6	66
9	1,800	1	1	4	15

#### ***Tributary Large Woody Debris***

The amount of large woody debris was considerably higher in the tributaries than in the mainstem of the St. Regis River. Little Joe Creek had the highest amount of large woody debris per mile, while both Twelvemile Creek and Big Creek were higher than reference conditions of 156 pieces per mile for 3-4<sup>th</sup> order streams in the Lolo National Forest (Riggers et al. 1998) (**Table E-5**).

**Table E-5. Large woody debris in Little Joe Creek, Twelvemile Creek, and Big Creek**

Tributary	Singles	Aggregates	#/Aggregate	Pieces/Mile
Little Joe Creek	1,072	51	17	1,205
Twelvemile Creek	445	46	10	195
Big Creek	106	1	20	329

**Mainstem Cross Section Measurements**

Cross section measurements for each of the three transects per reach were combined and reach averages were determined. Cross sections in Reaches 3 and 6 were performed in channelized portions of the river, while the sample site in Reach 5 was located in a wide aggraded section. Reaches 3 and 6 were F-type channels, while Reach 5 was a C-type channel (Rosgen 1996). Mean bankfull widths of 85.6 feet in Reach 3, 115.9 feet in Reach 5, and 60.1 feet in Reach 6 were measured in the riffle cross-sections (**Table E-6**). Rosgen (1996) maintains that a width/depth ratio greater than 10 to 12 characterizes both C and F-type stream channels, with higher values expected for streams with greater bankfull widths. Riggers et al. (1998) suggests a range from 10 to 33 for the width/depth ratios in C-type channels using data consistent with the reference approach that DEQ uses for interpreting water quality standards and setting TMDL targets. While there is no reference description for F-type channels, both Reach 3 and Reach 6 have high mean width/depth ratios indicating that the channel was generally wide and shallow in these two reaches.

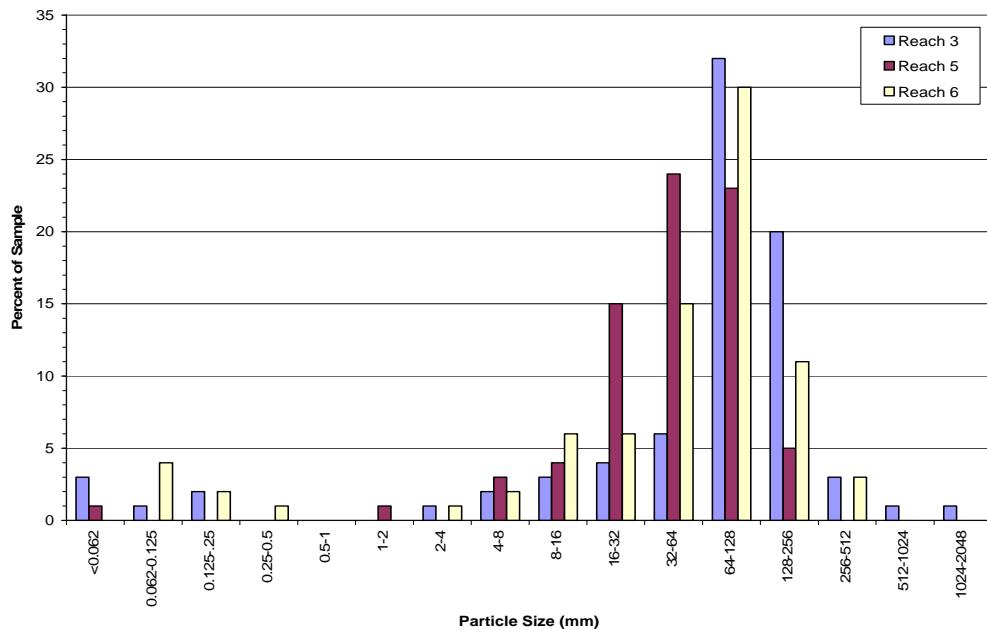
**Table E-6. Mean cross section measurements for Reaches 3, 5, and 6** (measurements in feet)

Reach	Bankfull Width	Flood Prone Width	Mean Bankfull Depth	Maximum Bankfull Depth	Width/Depth Ratio	D50 (mm)	D84 (mm)	Riffle PSF**	Channel Type
3	85.6	98.8	2.0*	2.8	42.9	96.7	207.3	3.6	F3
5	115.9	260.9	1.9*	2.7	61.2	56.6	112.0	3.9	C4
6	60.1	75.5	1.7	2.1	36.3	76.4	156.3	4.5	F3

\*Mean bankfull depths for Reaches 3 and 5 were estimated from the measured maximum bankfull depths. Mean bankfull depths were estimated as 0.7 of the maximum bankfull depth. This number was determined by comparing the differences between mean bankfull depth and maximum bankfull depth measurements for the other 7 reaches along the St. Regis River.

\*\* PSF – Percent Surface Fines < 6 mm

The D50 particle size was 96.7, 56.6, and 76.4 mm in Reaches 3, 5, and 6 respectively, while the D84 particle size was 207.3, 112.0, and 156.3 mm. The overall distribution of particle sizes is presented in **Figure E-1**. The mean percent surface fines < 6mm in riffles based on the grid-toss methodology was 3.6%, 3.9%, and 4.5% in Reaches 3, 5, and 6 respectively. These compare favorably with surface fines results < 6 mm based on grid toss methodology in undeveloped streams in the Lolo National Forest, where the data indicate a mean value of 7.6% surface fines in B channels and 8% surface fines in C-type channels in metasedimentary geologies under natural conditions (Riggers et al. 1998). However, surface fines assessments documented by Riggers are a composite of grid-toss measurements made in low gradient riffles and lateral scour pools along a reach of stream. Overall, it does not appear that a high amount of surface fines are accumulating in riffles of these three reaches. A mean riffle stability index value of 89 indicates excess sediment loads in Reach 5 (Kappesser 2002). Riffle stability index values were not calculated in the Reaches 3 and 6 due to the lack of bars.



**Figure E-1. Particle size distribution in riffles in Reaches 3, 5, and 6 along the St. Regis River**

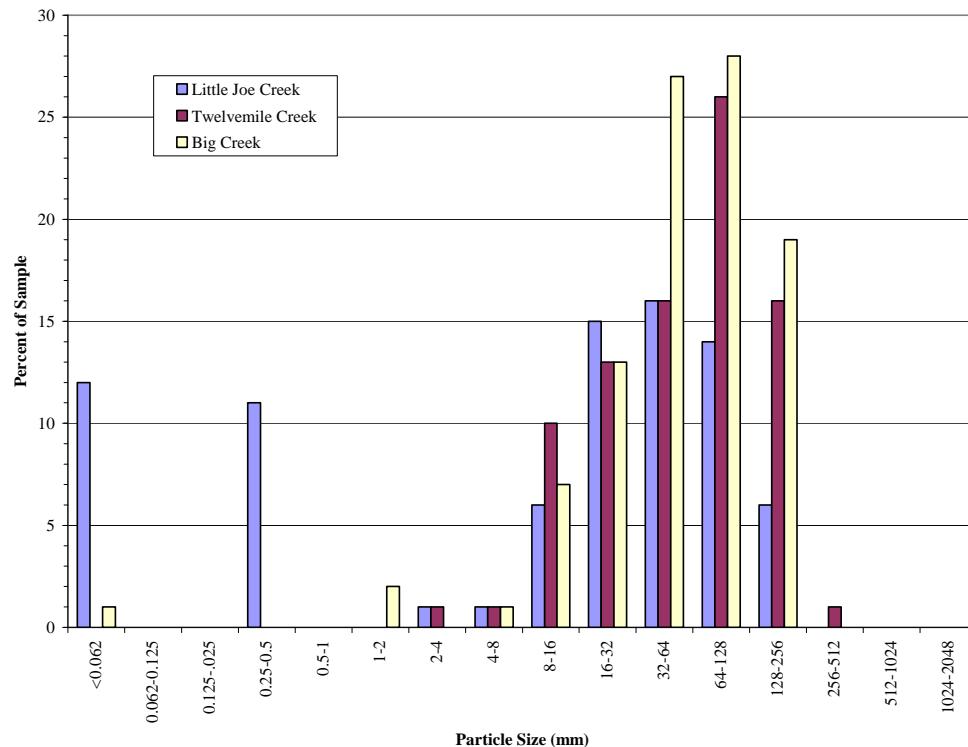
#### ***Tributary Cross Section Measurements***

Tributary measurements on Big Creek, Little Joe Creek and Twelvemile Creek conducted from the National Forest boundary to the confluence with the St. Regis River indicated these three tributaries were all C-type channels (Table E-7). Mean width/depth ratios fell within the range of 10 to 33 described as reference conditions for C3 and C4 channels on the Lolo National Forest (Riggers et al. 1998). Little Joe Creek had a D50 particle size of 27.3 mm and D84 particle size of 96.0 mm, while the D50 and D84 were 69.8 mm and 164.9 mm respectively for Twelvemile Creek. The D50 for Big Creek was 60.8 mm, while the D84 was 152.2 mm. Particle size distribution analysis indicates Little Joe Creek had the smallest substrate and the highest amount of fine sediment (Figure E-2).

**Table E-7. Mean cross section measurements for Little Joe Creek, Twelvemile Creek, and Big Creek between the National Forest boundary and the confluence with the St. Regis River (measurements in feet)**

Tributary	Bankfull Width	Flood Prone Width	Mean Bankfull Depth	Maximum Bankfull Depth	Width/Depth Ratio	D50 (mm)	D84 (mm)	Channel Type
Little Joe	64.2	350.0	2.3	2.6	27.9	27.3	96.0	C4
Twelvemile	39.8	93.3	1.7*	2.3	23.4	69.8	164.9	C3
Big	47.3	175.0	2.0	2.8	23.7	60.8	152.3	C4

\* Mean bankfull depths for Twelvemile Creek were estimated from the measured maximum bankfull depths. Mean bankfull depths were estimated as 0.7 of the maximum bankfull depth. This number was determined by comparing the differences between mean bankfull depth and maximum bankfull depth measurements for 7 reaches along the St. Regis River.



**Figure E-2. Particle size distribution in Little Joe Creek, Twelvemile Creek, and Big Creek between the National Forest boundary and the confluence with the St. Regis River**

#### *Proper Functioning Condition*

Sample sites in Reaches 4, 8, and 9 were in proper functioning condition, while sites in Reaches 1, 2, and 6 were functional at risk and sites in Reaches 3, 5, and 7 were nonfunctional (Table E-8). Based on the survey reaches, 29% of the overall length of the St. Regis River (excluding the headwaters in Reach 10) was in proper functioning condition, 35% was functional at risk, and 36% was nonfunctional. Assuming Reach 10 was in proper functioning condition indicates that 34% of the St. Regis River was in proper functioning condition, 32% was functional at risk, and 34% was nonfunctioning. Reaches in proper functioning condition were generally located away from Interstate 90. Essentially natural channel conditions and well-vegetated riparian corridors characterized these reaches. Reaches in a functional at risk category have adjusted to partially channelized conditions within a narrow but defined riparian corridor. However, functioning at risk reaches generally lacked in-stream habitat diversity. Reaches that were nonfunctional have been dramatically altered, either directly or indirectly, by the development of the transportation corridor. Nonfunctional reaches tended to be highly channelized and lacked development of anything beyond a streamside band of riparian vegetation. Reaches 3 and 7 met this description, while Reach 5 was aggravated with an extremely wide and braided channel.

**Table E-8. The condition of Reaches 1-9 along the St. Regis River based on the Proper Functioning Condition protocol developed by the Bureau of Land Management (BLM 1998)**

Reach	1	2	3	4	5	6	7	8	9
<b>Proper Functioning Condition</b>				X				X	X
<b>Functional at Risk</b>	X	X				X			
<b>Nonfunctional</b>			X		X		X		

***Fish Passage Assessment***

The majority of culverts associated with Interstate 90 and Frontage Road were large diameter, with low gradients and deep water in the bottom that did not appear to present any fish passage problems at low flows (**Table E-9**). Most of the surveyed culverts were corrugated metal pipes (CMP), though 2 concrete box culverts and a concrete arch culvert were assessed. Culverts under Interstate 90 ranged from approximately 125 to 300 feet long. These culverts may present problems at high flows due to their substantial lengths. The culvert on the St. Regis River mainstem at river station 185,000 was a fish barrier. This culvert, which was on Forest Service land, was an aging concrete arch with a three foot drop at the outlet. The culverts under Interstate 90 at river stations 178,500 and 187,000 may present fish passage barriers, especially at higher flows. The culvert transporting Randolph Creek under Interstate 90 may also be a fish passage barrier. The culvert on Silver Creek was not assessed, though it has been affirmed to be a fish passage barrier.

**Table E-9. Culverts assessed relative to fish passage**

Stream	Road	River Station	Length (Feet)	Diameter (HxW) (Feet)	Alignment (Degrees)	Type	Material	Outlet Drop	Bankfull Width Upstream (Feet)	Fish Barrier	Condition
Twelvemile	I90	68500	125	18	0	cmp	steel	none	35.3	no	good
Twin	I90	88200	300	8	15	cmp	steel	none	18	no	good
Twin	Frontage	89000	49	7 X 13	0	box	concrete	none	19	no	good
East Twin	Twin Cr	NA	48	4	15	cmp	steel	slight	9.2	no	good
Savenac	I90	98500	150	8 X 10	0	cmp	steel	none	28	no	good
Savenac	Frontage	98500	47	9 X 17	0	box	concrete	none	33.4	no	fair
Randolph	I90	158500	140	10	0	cmp	steel	1 foot	14.7	possible	good
Packer	?	NA	30	6	0	cmp	steel	none	15.7	no	good
Packer	?	NA	55	8	0	cmp	steel	none	16.8	no	good
St. Regis	I90	178500	160	8	0	cmp	steel	none	20	possible	good
St. Regis	?	185000	63	14 X 14	45	arch	concrete	3 foot	19	yes	poor
St. Regis	I90	187000	200	15	90	cmp	steel	none	20	possible	good

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